Return To: Hull

Dr. James C. Fletcher, NASA, Administrator
Banquet Address before the Antelope Valley Board of Trade, Lancaster, CA
October 18, 1974

Where Do We Go from Here in Space?

I welcome this opportunity to appear before the Antelope Valley Board of Trade to discuss the topic your president, Virgil Weaver, suggested: "Where do we go from here in space?"

It is especially appropriate that I discuss this question here tonight, because to a very large extent America's future in space, and the future of the world in space, is being shaped here in the Antelope Valley, as you develop the Space Shuttle Orbiter.

The Shuttle Orbiter development is one of the great technological undertakings of this decade, and indeed of this century. From the reports I have received, and the observations I have made, I am convinced you are doing a good job of it.

Congress and the White House have continued to give the Shuttle solid support, too. The funding we have received for Fiscal Year 1975 and the funding projected for the following years assure us of the opportunity to test the Shuttle Orbiter in horizontal flight in 1977, to fly it in orbit in 1979, and to begin operations with it in 1980.

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As you know, we plan to make the first horizontal flight tests of the shuttle orbiter at NASA's Flight Research Center at Edwards. In addition, we plan to utilize Edwards as a secondary landing site for operational shuttle flights when weather or other considerations make it desirable.

We are also seriously considering landing the first several Shuttle test flights at Edwards because of the added safety margins and good weather conditions during the first use of the automated landing system. Certainly it would be appropriate to have the orbiter return to Antelope Valley for a landing after its first flight in space, but we will, of course, base our final decision on the technical factors.

The Space Shuttle will come in time to have various landing sites. But you can always be proud of the fact that this technological marvel of our time -- the first true aerospace vehicle -- was built and first flown in the Antelope Valley.

The progress you are making on the Shuttle Orbiter at Palmdale and in the many sub-contractor plants is eloquent testimony to the high state of technology management and technology craftsmanship in this Valley.

I will be very glad when the Shuttle Orbiter begins flying. Then all the people who don't follow these things very closely will stop asking, "Whatever happened to the space program after Apollo?"

Almost everyone knew throughout the decade of the 1960s about the challenge we accepted in Apollo, and our response to it. The Space Shuttle will not be similarly well known, however, until it begins to fly.

But those of us who are working on the Shuttle know that it is the key to further space progress, the key to American leadership in space, and the key to a treasure chest of scientific and practical benefits to be won from space in the decades ahead.

It took foresight and courage on the part of the President and the Congress to make this long-range commitment to Shuttle development. But as I see it we had no other choice.

If we had not decided to build the Shuttle, the answer to your question, Where do we go from here in space?, would have been a simple one: Nowhere.

But with the Shuttle blueprints now being turned into hardware at Palmdale and elsewhere, I can give you an encouraging answer: We have a dynamic, wide-ranging, and highly productive space effort underway for this decade, and exciting plans for the future.

We cannot do everything we would like to do at this time. But we can continue taking the logical next steps in all the important directions. And we can do this on a stabilized annual budget of around $3 billion per year, including several hundred million for aeronautical R&D.

Here, then, are the main challenges we have set ourselves, and the main directions in which we are moving in the space program today:

One. Bring the Space Shuttle into operation by 1980.

Two. Develop productive new payloads for the Space Shuttle to win practical benefits and new understanding of the Universe.

Three. Continue our highly successful efforts to explore throughout the Solar System with automated spacecraft.

Four. Use our space capabilities and experience to help solve some of the pressing problems we face today right here on Earth.

Five. Develop the new technology needed for more productive and more far-ranging space missions in the future.

Now let me give you a few quick examples of what we are doing, and can do:

Example One: In 1976 we will soft land two sophisticated automated laboratories on the surface of Mars in an effort to obtain evidence of life elsewhere in the Solar System.

If we obtain such evidence, it will of course have profound impact on the origin of life in our own solar system and on the thinking of mankind.

Even if the search for life on Mars in the Viking program is inconclusive, the engineering problems involved, and their solutions (or perhaps at this stage I should say their intended solutions) will undoubtedly stir widespread interest among engineers and laymen alike.

Actually, most of the engineering work on Viking has been completed, but it is only when our automated spacecraft reach the scene of action that the dramatic story of challenge and response will begin to unfold for the public.

Viking is our most ambitious effort to explore the planets in this decade. In many ways, the engineering problems to be overcome are comparable in difficulty to those we solved in the Apollo missions to the Moon.

Of course, we do not have the problems of life support for men on the Viking mission, but the absence of astronauts makes successful operation of the life-detection laboratory experiments all the more difficult. So I think that in 1976 you are going to see evidence of broad advances in the technology of Solar System exploration, and, beyond that, in the general field of automation for possibly other applications in our society.

Consider for just a moment the effort it has taken to make automated instruments, which are necessary for meaningful life detection experiments, fit into a small cube-shaped package only one foot on a side, and to hold the weight of all these instruments down to about 36 pounds.

The life detecting instruments that have been re-designed to fit into one cubic foot of space aboard the Viking Lander would ordinarily weigh thousands of pounds and occupy several rooms in a college or industrial laboratory on Earth. So you might well say that these instruments have not only been re-designed but indeed re-invented.

This small package, called the Lander Biology Unit, will contain -- in its one cubic foot of space -- three automated chemical labs, a computer, a number of tiny ovens, counters for radioactive tracers, filters, a sun lamp, a gas chromatograph to identify chemicals, 40 thermostats, 22,000 transistors, 18,000 other electronic parts, and 43 miniature valves.

One of the Lander Biology experiments involves a Test for Metabolic Activity in which three soil samples will be moistened with a nutrient of organic compounds like sugar which bear trace chemicals. Instruments will monitor the gases given off by the samples over a period of about two weeks.

If the well-fed soil samples produce a steady flow of gases, this will be taken as evidence that living organisms in the soil consumed the nutrient; a steadily increasing production of gases will be taken as evidence of growth by the organisms.

To emphasize the complexity of the Viking experiments, let me remind you that these experiments must not only be performed within this tiny package, but their results must be analyzed and reported back to Earth, all automatically.

If Viking performs as expected, we will have convincing new evidence of the versatility and productivity of automated spacecraft. And the more we learn from this automatic equipment of the space age, the more we will want to send human explorers along with it on future expeditions. Not only will our interest in planetary exploration be stimulated by what our robots report, but our capabilities for sending human explorers to the planets will be greatly enhanced.

Viking is only one part of the comprehensive effort we are making to use automated spacecraft to explore throughout the Solar System during the next two decades.

Example Two: We have a fascinating engineering job to do in developing bigger and better instruments to use in exploring the Universe from Earth orbit. One of these is what we call the Large Space Telescope, which will weight about 10 tons; we will put it in orbit in the early 1980s, using the new Space Shuttle to launch it, to service it in orbit, and to bring it back to Earth for refurbishing after several years.

The Large Space Telescope will be in the three-meter, or 10-foot class. But because it operates in space, above the blanket of the Earth's atmosphere, it should be much more productive, in some fields, than the largest telescopes on Earth.

The resolution of the LST is impressive. If you had it mounted in Lancaster, and if the Earth was flat, you could see the headlights of a car in Tokyo, and you could tell that the car had two headlights and not just one.

The LST will enable astronomers to see 10 times further into space than they can now. It may enable them to see to the edge of the universe. When we use the LST to look at distant galaxies, we will not see them as they are today, but as they were billions of years ago.

Closer to home, the LST may let us see evidence of planets circling nearby stars, planets that our descendants hundreds of years from now may try to visit, planets that we may contact by radio in our own lifetimes.

The astronomers will use the LST to obtain knowledge. But engineers will use it, and its scientific findings, to vigorously pursue new technology for direct application to the problems of man and his environment. There has been some opposition in Congress to proceeding with development of the LST in the next fiscal year, as we hope to do, but I see the LST as a classic example of the kind of effort we must make if we want to remain the leaders in high technology on Earth.

Example Three: When we first began thinking about the Space Shuttle, we thought of it as a vehicle to serve a large space station in Earth orbit. But we ran into a dilemma: we found that we could not expect to get the funding to build both a large space station and the Space Shuttle in this decade.

A space station would be of no use without the Shuttle. And at first we thought that the reverse was also true -- that a Shuttle would be of little use without a space station to serve. But the more we looked at this, the clearer it became that no dilemma existed but rather an opportunity. With some modifications in our Shuttle planning, we found we could very effectively use the Shuttle not only as a launcher and servicer of automated spacecraft but also as the carrier of a small but highly versatile and highly productive manned space station.

We call this manned space station the Spacelab. It has been designed to be lifted in and out of the cargo bay of the Shuttle, which as you probably know is 15 feet in diameter, 60 feet long, and intended for payloads up to 65,000 pounds.

The scientists who work in orbit in Spacelab will not need to be astronauts. A healthy man or woman would be able to make the trip.

We built another challenge -- or sub-challenge -- into the Shuttle effort. We wanted to enlist the cooperation of European nations in a way that would be mutually advantageous and save U. S. dollars. We found the Europeans receptive to the idea of developing the Spacelab, at a cost to them of around $400 million or more, and a corresponding saving to the U. S.

This is so far the most significant international cooperative effort ever attempted. I am most encouraged by the success of our persistent efforts to enlist the cooperation of other industrialized nations in exploring and using space.

Example Four: This is a challenge to be shared by NASA and private industry. This joint challenge is to demonstrate and use the Spacelab in the 1980s to produce valuable new products and new techniques.

NASA has already made a substantial investment in demonstrating the feasibility of space processing in the Skylab program. Additional experiments will be carried out during the Apollo-Soyuz Test Project next July, when an American and a Soviet spacecraft rendezvous and dock in Earth orbit. And, of course, the Spacelab is being designed and equipped to facilitate its use for space processing experiments.

When the Space Shuttle and the Spacelab are operating in the 1980s, the vacuum and the weightlessness of space flight will be available to the metallurgists, the crystal growers, and the pharmaceutical companies who know how to use them, or want to try.

Example Five: NASA is working in a number of ways -- independently and in cooperation with other Government agencies -- to help find long-range solutions to current energy shortages. One major challenge in this field, which we have gladly accepted, is to determine the technological and economic feasibility of gathering solar energy aboard a spacecraft in synchronous orbit, converting it to microwave, beaming it to a collector station on Earth, and reconverting it to a useful form for the nation's power grid.

The advantages of using spacecraft to help meet energy needs are obvious, if we can learn how to do it at reasonable cost.

The supply of potential power is there for the taking, 24 hours a day, in unlimited quantities. There would be no pollution. And so forth.

We recognize that several very substantial advances in the state of the art must be made before we can begin to build a large-scale space-based solar power system.

For example, the cost of the solar cells used in Earth orbit to turn sunlight into electricity will have to be greatly reduced (or an alternative method for turning the sun's heat into electricity will have to be perfected). We are working on that.

The microwave beam sent from the space power station will have to be uniquely well focused to be contained within a ground target area five kilometers in diameter. We are working on that.

Techniques for receiving microwave transmissions and converting them to direct current will have to be greatly improved. We are working on that.

Just recently we took a small but significant step forward in one of our space power experiments. At the Jet Propulsion Laboratory here in California and in the laboratories of our contractor, the Raytheon Company, we have been working on wireless power transmission. We started by beaming small amounts of power over distances of several meters at an overall efficiency of about 50 percent. This was done in the laboratory. Then the experiments moved to the site of one of NASA's Deep Space Tracking Network stations at Goldstone. There, a new record for wireless transmission of power was established on September 16 when approximately one kilowatt of DC power was delivered through an experimental receiving device one mile away from the transmitter. In tests next summer, using a larger receiving array, we expect to increase the power level delivered by the receiver to 12.5 kilowatts or more, over the same one mile range.

This is admittedly a small first step, but it could be the start of a very important enterprise for all of us in the decades of diminishing fossil fuels ahead of us.

Our eventual aim is to achieve an overall efficiency in wireless power transmission of about 70 percent. That would probably suffice for transmission of cheap power from Earth orbit, but, of course, it would never compete with the 95 percent efficiency of transmission by wire here on Earth.

Conclusion: I hope I have given you some indication of the significant advances we will be making along all the major avenues of space progress in this decade and the next.

Late last year we completed a detailed planning study which indicates in great detail the kinds of missions we expect to fly in Earth orbit and throughout the Solar System up through the year 1991. This study is called The 1973 NASA Payload Model. It has been published as part of our Congressional testimony, and copies can be obtained from NASA Headquarters.

At the present time, we are engaged in two new long-range planning studies called "Outlook for Space" and "Outlook for Aeronautics". These new studies will seek to identify the most rewarding directions we can take in space and aeronautical research and development between now and the Year 2000. They will seek to identify not only the most promising or most exciting possibilities, but also those that tie in most closely with our overall national goals and national needs during this time period, that is, during the remainder of this century.

These studies are to be completed next year. I want to emphasize that these new studies are primarily an in-house NASA effort to develop the guidelines and background we need, so we can recommend the most rewarding and most needed new programs over the years ahead.

You may ask, how will our new study, "The Outlook for Space", differ from our current planning document, "The 1973 NASA Payload Model"?

For one thing, the new study will look about 10 years further into the future. But the big difference will be this. When the 1973 Payload Model was drawn up, we limited ourselves to missions that could be flown with or without the Space Shuttle.

So, our 1973 Payload Model reflected the uncertainty whether the Space Shuttle would win final Congressional approval or not. I am happy to say, this uncertainty is now clearly removed. Our new study has the very important purpose of calling upon NASA and the aerospace industry and the science community and government agencies interested in space applications to use their imaginations and their engineering and management know-how to take full advantage of the new opportunities offered to us by the Space Shuttle and the Spacelab.

For example, anticipated availability of the Space Shuttle makes it much more feasible for us to think about returning to the Moon in the decades ahead. It makes the production and delivery of power from space to Earth a realistic engineering and economic problem instead of a science fiction dream.

"Where do we go from here in space?" We are going the Shuttle route for benefits from Earth orbit, and we are going to explore the Solar System, with automated spacecraft and then eventually to extend man's habitat to the entire Solar System.

I thank you.